DOCUMENT RESUME

ED 105 926 JC 750 319

AUTHOR	Riggle, G. Thomas, II
TITLE	Developmental Mathematics from the Student's Point of View.
PUB DATE	30 Apr 75
NOTE	52p.; Practicum presented to Nova University in partial fulfillment of the requirements for the Doctor of Education degree
EDRS PRICE	MF-$0.76 HC-$3.32 PLUS POSTAGE
DESCRIPTORS	Autoinstructional Aids; Community Colleges; Computer Assisted Instruction; *Developmental Programs; Evening Programs; *Individualized Instruction; *Junior Colleges; Peer Teaching; Practicums; Programed Instruction; *Program Evaluation; Questionnaires; *Remedial Mathematics; Remedial Programs; Student Attitudes; Student Characteristics; Tutorial Programs
IDENTIFIERS	*Cuyahoga Community College (Metropolitan Campus)

ABSTRACT

Since 1970, the developmental mathematics program at the Metropolitan Campus of Cuyahoga Community College (Ohio) has consisted of three courses of individualized instruction. A pretest is given to determine proper course placement and all modular units are accompanied by regular lectures. This practicum was designed to determine the attitudes, perceived needs, and recommendations of the students enrolled in the program, and to ascertain the degree to which they utilized the supplementary services (peer tutoring, audio-slide presentations, and computer tutorial service). A stratified sample of 91 students (6.4 percent of the total developmental math enrollment) was selected. The attitudes of day and night students are compared, as are those of students enrolled in each of the three program courses. Results indicate a general satisfaction with the program; however, many students did not use the supplementary services and many had never heard of them. The author recommends that (1) each student be given a tour and an explanation of the facilities and services; (2) all students be required to take the placement test; (3) sample unit tests be available for student review; (4) tutors become familiar with texts used in class; and (5) a coordinator work to inform the night faculty of the intentions of the program. The questionnaire, with tabulated responses, is appended. (DC)

ED105926

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

DEVELOPMENTAL MATHEMATICS FROM THE STUDENT'S POINT OF VIEW

by

G. Thomas Riggle II, M.S.

Cuyahoga Community

College

A PRACTICUM PRESENTED TO NOVA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF EDUCATION

NOVA UNIVERSITY

April 30, 1975

JC 750 319

TABLE OF CONTENTS

List of Tables iii

List of Figures iv

I. Introduction 1

II. Background and Significance 1

III. Procedure 7

IV. Limitations of the Study 11

V. Results 11

VI. Recommendations 28

VII. Further Studies 34

VIII. Summary 35

Bibliography 37

Appendix 39

LIST OF TABLES

Table		Page
1.	Category Array for Stratifying the Population Sample	9
2.	Sizes of Subsamples Used	12
3.	Analysis of Course Meeting Time Preferences	18
4.	Analysis of Opinions on the Clarity of Module Booklet Explanations, Day and Night Student Attitudes	19
5.	Analysis of Opinions about Using Homework as Part of Student Grades	20
6.	Analysis of Opinion on Withdrawal Policy	21
7.	Analysis of Female Enrollment in Module Courses 091, 095, and 101 . . .	21
8.	Analysis of Female Student Enrollment in Developmental Mathematics Courses (a) 091 and 095; (b) 091 and 101; and (c) 095 and 101	22
9.	Analysis of Transfer Plans of Students in courses 091, 095, and 101	23
10.	Comparison of Transfer Plans for Students in 095-101 versus 091	24
11.	Analysis of Opinions on the Clarity of Module Booklet Explanations, Course 091, 095 and 101 Student Attitudes	25
12.	Analysis of Opinions on the Clarity of Module Booklet Explanations in Courses (a) 091 and 095; (b) 091 and 101; and (c) 095 and 101	26
13.	Analysis of Attitudes of 091-101 students versus 095 students concerning the Helpfulness of the Mathematics Department Tutoring Service	27

Table Page

14. Analysis of Attitudes of 095-101 students versus 091 students concerning the Quantity of Tutors Available 28

LIST OF FIGURES

Figure Page

1. Comparison by Age of Day and Night Students 13

I. INTRODUCTION

The Metropolitan Campus of Cuyahoga Community College has invested great expense and effort in its developmental mathematics program. This practicum is one phase of an evaluation of all developmental education at this institution. While other studies will evaluate the effectiveness of the developmental mathematics program from the standpoint of academic achievement, this study obtained an evaluation of the program from the viewpoint of the students using it. In particular the author determined student attitudes, perceived needs and recommendations. Further, the degree of student usage of supplementary facilities was established.

II. BACKGROUND AND SIGNIFICANCE

The present developmental mathematics program at the Metropolitan Campus evolved from a memorandum sent by the mathematics department faculty to the dean in 1970. The memorandum expressed faculty concern over the 30% rate of withdrawal or failure in mathematics courses, and proposed a solution in the form of an individualized instructional system. It was felt that the contributing factors to student withdrawal/failure were improper placement, instruction materials used and instructional methods. The instructional method used was principally lecture-discussion, which assumes that all of the students in a particular class are at the

same level of methematical proficiency, learn at the same rate and learn in the same way. To allow for student differences in these areas an individualized instructional program was devised for the three developmental mathematics courses--College Arithmetic 091, Algebra 095, and Algebra 101. The content of these courses was rewritten by the mathematics faculty into small units called modules. Placement tests were given to each student during the initial class meeting to determine proper course placement and which modules, if any, might be deleted from the student's course of study. Attendance was optional and the instructor served to answer student questions, collect and distribute student papers, and give occasional lectures to small groups of students. Resulting problems led to compulsory attendance and regular lectures given at the pace required to complete the course. Students were still allowed to work faster or slower than the suggested pace. Each module consisted of textual material followed by practice sets with detailed solutions for the student to study and problem sets to be worked and turned in for grading. Supplementary sets were given to students who received a score of less than 70% on the original problem set. These additional sets were given until the student achieved a passing score. Once the problem sets had been passed, a module test was given to the student. A student who had received less than 70% on the module test restudied and retook different forms of the test until a score of 70% or more was achieved. When tests were

retaken only two grades were given, 70% and unsatisfactory. Once all the module tests were passed a final examination was given. A student's grade was based solely upon the module tests and the final, not on the homework. If a student didn't achieve an overall course average of at least 70% after two tries on the final exam he was assigned a grade of D or a withdrawal by the instructor. A grading scale of C (70% - 79%), B (80% - 89%) and A (90% - 100%) was used, and a student who had a module test average of 85% or higher could be exempted from taking the final. At the end of the quarter a student who had only one module to complete in the course was given an incomplete (I) grade and allowed to enroll in the next consecutive course where he would finish the remaining module before moving on to the new modules. A student who was more than one module behind was given an automatic withdrawal (w) grade and was forced to reregister in the same course, but continued working from where he left off in the last course.

Several supplementary services were available to the students. Free tutoring in a mathematics lab was provided at the onset of the program. Student assistants staffed the lab from 9a.m. to 8 p.m. with faculty members being available in the lab at limited times. More recent services are audio-slide presentations and computer tutorial programs on difficult areas.

The original plan involved modularizing all of the mathematics courses. In fact a time schedule was proposed

that would have all of the beginning and intermediate courses individualized by the end of 1972, and the advanced courses would be ready in 1973-74. The enormity and intricacy of this project was grossly underestimated. At the present time only the three beginning courses have been completed, and no departmental effort is being made to expand this instructional technique to other mathematics courses. Rather, current work is with the audio-slide presentations and computer tutorial programs.

Two studies have been made to evaluate various aspects of these developmental mathematics courses. In 1972 the mathematics department found that in all three courses (091, 095 and 101) the withdrawal rates with the new teaching method were significantly higher than those with the old teaching method. This may have been a natural result of the nature of the program. Allowing students to proceed at their own pace would likely produce a larger number of students who didn't finish the course and therefore received withdrawal grades.

In 1974 the author tested the validity of the placement tests being used in Algebra 095 and Algebra 101. It was found that a significant (at the 1% level) correlation existed between the placement test score and the final numerical grade in both courses.

A further finding was that the cut-off score of 60% on the appropriate placement test was a significant (at the 5% level) predictor of student success in passing the course.

The idea for this study came from a statement by Dr. Nolan Ellison, the new president of Cuayhoga Community College. He stated that many areas of funding had been nearly automatic in the past, but future financial requests would need to show further justification. Developmental education was one of the areas he mentioned in particular. The author felt the mathematics department should take the initiative by examining the developmental mathematics program. With encouragement from the department chairman and the campus president, the author set out to isolate an area of study of importance, but of manageable size.

Harold Benjamin points out in his excellent satire, Saber-Tooth Curriculum, that education becomes scientific in proportion to the increasing willingness of the educators to test their hypotheses. (10, p. 11) While this idea is generally accepted, the extent of what should be changed, tested or not, varies greatly. Ronald Gross presents a strong commentary on education:

> Life is learning; but learning dies when it is constrained in a certain place, provided only for a select group, conveyed through certain people and media, confined to outmoded categories of thought, chopped up in courses, periods, units, lessons, lectures, measured by invidious certificates and credentials. (5, p. 8)

"HOGWASH", was Galen Saylor's response to Cross. According to Saylor, the present educational system is viable, but needs redirecting toward transmission of society's culture, socialization of the young and contributing fully to the

maximum development of each student. (12, p. 44) The author was struck by thoughts along this line from Alvin Toffler and Margaret Mead. In Future Shock Toffler named education's central task to be "expanding man's adaptive capacities" since educators will be unable to accurately predict students' future needs. (14, p. 397) Margaret Mead's comments apply to education as well as society in general. She postulates the need to create new models for adults to use in teaching children not what to learn but how to learn and not what they should be committed to, but the value of commitment. (7, p. 92)

The author felt a thread of commonality in these varied ideas; to wit, a shift of emphasis from the teacher or subject to the learner. An excellent summation statement is given by K. Patricia Cross in Beyond the Open Door. She said, "In the final analysis, enabling people to learn--however, whenever, and whatever they have a need or desire to learn--is the aim of all education." (2, p. 174)

How can the educational system purport to serve the needs of the student unless it considers input from him? The professional educator often tends to look only at academic achievement and not at student attitudes. Barton Herrscher raises the question, "What has been achieved if the student, while mastering the objectives of a course, has learned to hate the subject?" (6, p. 20)

The author chose to restrict his study to gathering student input about the developmental mathematics courses--

their attitudes, perceived needs and recommendations. A secondary consideration is the determination of student usage and opinion of the supplementary services offered by the mathematics department. The importance of these developmental courses cannot be overemphasized as they enroll more than 60% of all the mathematics students at the Metropolitan Campus.

III. PROCEDURE

The process followed by the author in organizing the study was based upon the second chapter in Surveys, Polls, and Samples written by Mildred Parten. (8, pp. 48-69) The author developed a list of topics of concern to the mathematics department related to the developmental courses. This list was given to the department chairman and the other mathematics faculty members for their comments, deletions, and additions to the list. The list of topics was converted into a questionnaire whose construction relied heavily upon the Parten book mentioned before (8, pp. 157-217) and an excellent book, The Art of Asking Questions by Stanley Payne. Particularly useful was Payne's checklist of guiding principles. (9, pp. 228-237) In constructing the questionnaire the author gave special consideration to the principles of using simple words and short sentences, making statements precise and unambiguous, keeping the responses uniform as much as possible, and finally keeping the time

required to complete the questionnaire to a minimum. This initial form of the questionnaire was presented to the mathematics faculty and department chairman for their suggestions. Based upon the numerous suggestions, the author wrote a revised form which once again went to the mathematics faculty and cluster coordinator for more comments. This form was pretested with five students to get their advice and to see if the form could be answered in ten minutes or less. The time required to answer the questionnaire was less than ten minutes so the final form using the latest suggestions was written by the author. One unexpected change in the questionnaire was in the area of student major. While meeting with the five students from the pretest group, they indicated that students in these developmental courses have only a vague notion of their major. The students suggested using the general categories--mathematics-science, liberal arts, or undecided. This meant dropping the author's idea of testing whether students in various majors had unique problems related to the developmental mathematics courses. Since the pretest students felt very strongly about this point, the author conceded it to them. While the author was interested only in responses of agree, undecided and disagree, a five choice scale was used in hopes of getting fewer undecided responses.

In approving this study the mathematics department chairman requested that the two Saturday classes not be used as their time is too limited and he further requested that

all of the classes be disrupted as little as possible. The rationale for this request was the lateness of the quarter and the class time already lost due to a campus-wide faculty evaluation the previous week. The author found the best way of meeting this request and still getting a valid sample was to use a hybrid of two techniques. The population was stratified according to day and night sections and according to courses 091, 095 and 101 (see Table 1). (13, p. 520) Then the technique of choosing a random cluster from each category or stratum was used to get the subsamples. (15, p. 108)

Table 1. Category Array for Stratifying the Population Sample

Course Number	Meeting Time		Total
	Day	Night	
091			
095			
101			
Total			

The sample size required for the survey was based upon several considerations. Two standard formulas gave the required sample size as 24 and 73. (8, pp. 314-316) The author chose to use the 73 and thus possibly have a larger sample than necessary. Besides the size of the total sample, the author had to consider the size of the

subsample in each category. Mildred Parten gives a rule of thumb stating that each category should have at least ten members. (8, p. 298) In order to get at least ten students in each subsample the author had to increase the total sample from 73 to 91.

In collecting the data the author chose classes at random in each category and administered the survey to these sections. Thus every course and time was represented in the survey. A random sample of 6.36% of the students tested in each subsample were chosen so that the subsamples didn't have to be weighted for nonproportionality in performing the statistical analyses. Once the data was collected the totals for each item on the questionnaire were converted to percentage figures for easier inspection. In addition to the total sample these percentage calculations were made for the following subsamples: day students, night students, 091 students, 095 students, and 101 students. The responses of these various subsamples were compared for notable differences. Prominent differences were tested for significance to determine if the differences were greater than could be expected by chance variation. The statistical analysis used was chi-square as described in Freda Conway's introductory text to sampling techniques. (1, pp. 37-48, 51) The general formula used was: chi-square = $\frac{(O - E)^2}{E}$ where O = occurences and E = expected occurences. Since the data was discrete a correction for continuity developed by Pirie and Hamden was used in all cases where the degree of

freedom equaled one. (11, pp. 693-701) Their corrected formula was:

$$\frac{(|O - E| - .5)^2}{E}.$$

In testing for differences between responses of various subsamples, decisions had to be made on how to group the responses. Basic Statistical Methods by Downie and Heath (3, pp. 198-199) and Statistical Inference by Richard Ellis (4, pp. 178-182) were consulted for examples of when to combine or delete categories to improve analysis and test validity.

IV. LIMITATIONS OF THE STUDY

This study has the following limitations, some due to the exigencies of time and complexity:

1. The two weekend sections were not considered.
2. The results from the Spring quarter may not be typical of other quarters.
3. The survey was done near the end of a quarter when some students had already dropped.
4. The results of this study may not be applicable to other departments, campuses or colleges.
5. The sample may not be representative of the population.

V. RESULTS

The sample of 91 students was picked from a total

population of 1,431 by means of six subsamples whose sizes are indicated in Table 2 below. The sample of individuals in each category represents $\frac{91}{1,431}$ or 6.36% of the possible number of students in that category. This was done so that the numbers to be used in any statistical analyses would not require weighting because of disproportionate sizes of any of the subsamples.

Table 2. Sizes of Subsamples Used

Course Number	Meeting Time		Total
	Day	Night	
091	20	17	37
095	18	10	28
101	13	13	26
Total	51	40	91

Two items on the questionnaire had to be deleted as poorly stated questions. Number five requested input on grade point average, but the responses were divided between grade point average and current module test average. The other question (#10) dealt with the number of module courses the student had taken. The student responses indicated confusion between number of module courses taken and the number of units or modules finished in the present course.

The general information sheet responses indicated that 58% of the student mathematics population were males. Further, eighty-five per cent of the students are under 29

years of age with the largest category being 20-24 years (36%). Figure 1 below illustrates the difference in ages between the day and night students. The evening student age curve is skewed to the right with the bulk of the students in the age range 20-29, while the bulk of the day students' ages are in the 24 and under age range.

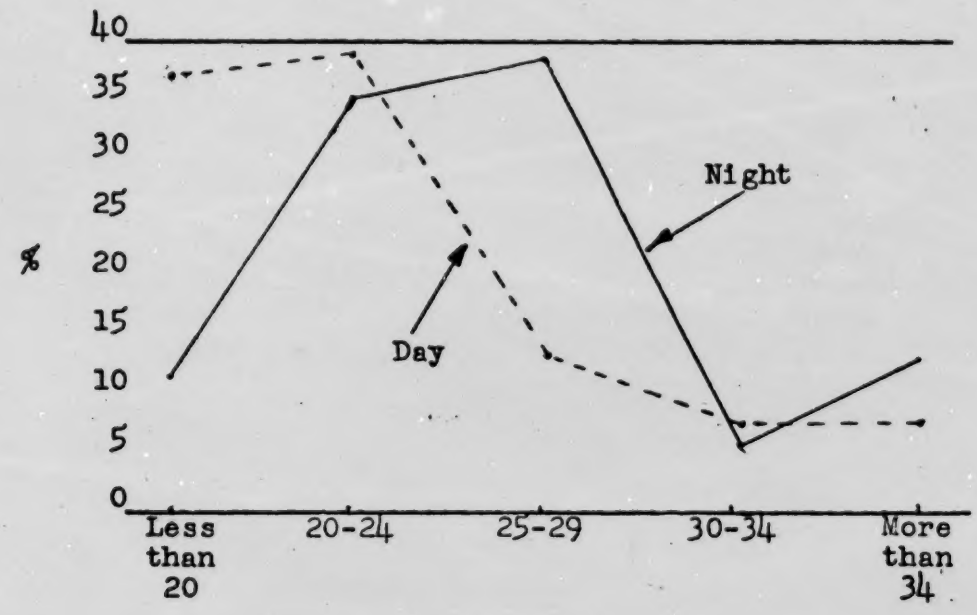


Figure 1. Comparison by Age of the Day and Evening Students

The percentage of transfer students was slightly larger than that of the two-year students, 48% to 42%. While students favored majoring in the mathematics-science area (33%) to the liberal arts area (22%), quite a sizable per cent of them were undecided (45%). It should be noted that throughout the study the percentage totals do not nec-

essarily total to 100%, since the students could not be required to answer any question. Even though the author expected that many of the students had jobs, the quantity was unexpected. Over 68% of the students work at least part time and 44% work 40 hours or more per week. This last figure is greatly influenced by the night students, 85% of whom work full time. The day time mathematics courses enrolled 56% of the students, but 66% of the students expressed a preference for day classes. The last item on the general information page concerned the student's reason for taking the course. A majority of the students (68%) were fulfilling school requirements. Twenty-two per cent took the course due to a recommendation and only 7% took the course as part of a job requirement.

Attitudes about the teaching method were surveyed by questions 12 through 18. Eighty-three per cent or more of the respondents agreed that the student information sheet clearly explained the course structure and policies, that the module booklet explanations and detailed solutions were very helpful, and that the individualized module program is a good teaching method. Nearly 80% of the students felt that not only could they recommend the module courses to a friend, but they preferred the module teaching approach to the traditional lecture textbook approach. The only sizable negative reaction was a 21% response of disagreement to the statement that the module booklets give clear explanations. In the matter of attendance 83% of the students felt that

it was necessary to attend more than 3/4 of the classes and 59% of the students felt that nearly every class must be attended.

Views on homework were covered by items 19 through 23. Students generally agreed that extra problem sets should be required if a student received less than 70% on a homework set and further that doing extra sets of problems helped students learn. Opinion on whether or not homework should be part of the student's grade was divided with 55% favoring and 38% opposing. The statement "students feel resentful and discouraged when they get an extra set of problems to do" received responses of 38% agreement and 31% disagreement, indicating an area for further investigation. Finally 93% of the students spend six or less hours on homework and 42% of the students spend less than three hours.

The section on grading (items 24-30) yielded higher percentages of "undecided" responses than the previous sections. Students generally agreed that studying for a final examination increased a student's knowledge of the course content, but at the same time it was felt that a student with a test average of 85% of higher should have the option of skipping the final. Fifty-two per cent of the students stated that the placement test did its job, while 8% disagreed with this opinion and 37% were undecided. The large number of undecided responses may be from students who did not attend the first class meeting when the placement test was given. In three of the items 46% - 47% of the responses

were negative with a positive response of 22% to 26%. These three items concerned having a student retake the course if he finished more than one module behind, allowing a student with a test average of 70% or more the option of skipping the final, and grading the module courses on a pass/fail basis. When queried as to what maximum score a student should receive on a retest over an area previously failed, students answered to the four choices in the following percentages--a maximum grade of 70% (12%), maximum grade of 80% (17%), a maximum grade of 90% (18%) and whatever score he earns (51%).

The supplemental services section (items 31-35) elicited surprisingly large expressions of indecision, ranging from 42% to 75%. The free tutoring was considered very helpful (48% agreed and 10% disagreed). Twenty-five per cent of the students said there were sufficient numbers of tutors and 16% said there were not. The question on the utility of the mathematics department computer reflected limited student opinion with 14% agreeing and 4% disagreeing and the bulk of the student undecided (75%). The reason for the great indecisiveness on the part of the students becomes clear upon examining the last two items pertaining to the degree of student use of the tutoring and computer facilities. Sixty-two per cent of the students never used the tutoring service and an additional 6% didn't know about it. The opportunity to use the computer for drill wasn't taken by 24% of the students and 78% of the students didn't

know about using the computer for practice.

A final section of the questionnaire allowed students to present their comments. Most of these statements were reinforcing responses given to items in the questionnaire. While a number of students expressed favorable attitudes toward the program, not one student expressed dislike of it. This was enlightening to the author who personally has doubts about the program. The general suggestions were for more teacher explanation of the module material, tutoring for evening and weekend students, and putting other mathematics courses into modules. Modules 13, 14, and 18 were specifically singled out as needing more examples and clarity of explanation. It also came to light that there are two different forms of a module booklet being used in some classes leading to student confusion. Lastly at least one evening class is self-paced in name only as the students all take their tests together whether they have done all of the necessary homework or not.

An examination of the responses of the total sample yields a general profile of student attitude toward the developmental mathematics program. In order to gain further insight into problem areas it is necessary to compare the responses of the different subsamples--day versus night and 091 versus 095 versus 101. The author analyzed apparent differences in responses from the various subsamples by formulating a null Hypothesis and testing it for significance at the .05 level using chi- square techniques. Only those

areas whose tests indicated a significant difference are given as there were nearly thirty areas tested. The first four areas involved comparisons between the attitudes of day and night students.

Area 1 - Preference for day or night classes (question #9)

Very few students preferred to take mathematics at night but nearly 73% of the night students preferred to take mathematics in the day. Table 3 below summarizes the test which showed that this was a significant difference in preference. It is difficult to see any way to solve this dilemma. Some of the night students may not have been able to get a day section, but most students take night courses because they work during the day.

Table 3. Analysis of Course Meeting Time Preferences

H_o: There is no significant difference between day and evening student preference for day or evening classes.

Time of Present Course	Preferred Time for Course	
	Day	Night
Day	49	2
Night	10	27

Chi-square is 46.2; significant (.001); reject H_o

Area 2 - Clarity of module booklet explanations, day and night student attitudes (question #13)

There is a significant difference between the opinions of the day and night students concerning the clarity of the explanations of the module booklets (see Table 4 below). This difference may not be due to the groups themselves, but rather to the differences in class period frequency and length at night.

Table 4. Analysis of Opinions on the Clarity of Module Booklet Explanations, day and night student attitudes

H_o: There is no significant difference between the day and night student opinions concerning the clarity of the module booklet explanations.

Time of Present Course	Opinion	
	Agree	Disagree
Day	41	5
Night	22	14

Chi-square is 3.90; significant (.05); reject H_o

Area 3 - Attitude toward using homework scores in student grade (question #19)

The night students feel more than two to one that homework should count as part of the student's grade, while the day students are about evenly split. That this difference is significant is shown in Table 5 below. This study

has found that the night students are older, more often have a full time job, and spend less time on homework. The effort devoted to homework probably means a greater sacrifice in time to the night students and therefore homework assumes greater importance.

Table 5. Analysis of Opinions about Using Homework as Part of Student Grade

H_o: There is no significant difference between the day and night students' attitudes toward having homework count as part of the student grade.

Time of Present Course	Opinion	
	Agree	Disagree
Day	22	24
Night	28	11

Chi-square is 4.99; significant (.05); reject H_o

Area 4 - Attitude toward required withdrawal (question # 25)

When a student finishes a course more than one module behind, he is given a withdrawal grade and takes the course over. The night students have no group preference, but day students responded against the idea three to one. The difference between the groups was significant (see Table 6 below), but no reason for this difference seems apparent. More detailed investigations might explain the day student opposition.

Table 6. Analysis of Opinion on Withdrawal Policy

H_o: There is no significant difference in attitude in day and night students toward having to retake a course when finishing the quarter more than one module behind.

Time of Present Course	Opinion	
	Agree	Disagree
Day	10	30
Night	13	12

Chi-square is 4.89; significant (.05); reject H_o

The next series of areas concerned comparing the responses of students by class--091, 095, or 101 or by various pairings of classes.

Area 5 - Female/male enrollment differences (question #1)

Table 7. Analysis of Female Enrollment in Module Courses 091, 095 and 101

H_o: There is no significant difference in the number of female students in the courses 091, 095 and 101.

Sex	Course Number		
	091	095	101
F	22	15	2
M	15	13	24

Chi-square is 13.02; significant (.01); reject H_o

The results of the chi-square test given in Table 7 above indicate that the null hypothesis may be rejected, but there are several possible alternatives. So a further 3-part hypothesis was considered to determine if one particular course is responsible for the difference in female enrollment. The analyses given in Table 8 below show that the 101 course has a significantly lower female student enrollment than 091 or 095. This may be the result of majors which predominantly attract male students having algebra 101 as a requirement. It might be the case that the female students who would need algebra 101 have already taken its equivalent in secondary school and thus start with more advanced mathematics courses.

Table 8. Analyses of Female Student Enrollment in Developmental Mathematics Courses a) 091 and 095; b) 091 and 101; and c) 095 and 101.

H_o: There is no significant difference in the number of female students in courses
a) 091 and 095
b) 091 and 101
c) 095 and 101.

	Sex	Courses	
		091	095
a)	F	22	15
	M	15	13
Chi-square is .22; not significant; fail to reject			
		091	101
b)	F	22	2
	M	15	24
Chi-square is 17.3; significant (.01); reject H_o			

Sex	Courses	
	095	101
c) F	15	2
M	13	24
Chi-square is 13.1; significant (.01); reject H_o		

Area 6 - Relationship between courses and student's transfer plans (question #3)

Table 9. Analysis of Transfer Plans of Students in Courses 091, 095, and 101.

H_o: There is no significant difference between students is courses 091, 095, and 101 in their plans to transfer or not.

Course	Transfer Intention	
	Transfer	Not Transfer
091	11	21
095	20	7
101	13	10
Chi-square is 9.05; significant (.05); reject H_o		

The chi-square statistic in Table 9 above indicates that the null hypothesis may be rejected and that there is a significant difference between transfer plans for students in the three courses. Of the various additional tests that were made, only the comparison of 095-101 to 091 gave a significant difference as is shown in Table 10.

Table 10. Comparison of Transfer Plans for Students in 095-101 versus 091.

H_o: There is no significant difference between the students in courses 095-101 and 091 in their plans to transfer or not.

Course	Transfer Intention	
	Transfer	Not Transfer
091	11	21
095-101	33	17

Chi-square is 7.83; significant (.05); reject H_o

It seems that the college arithmetic 091 students are interested in strengthening their mathematical abilities for present course work as they indicate less interest in transferring. Whereas a larger number of the students in 095 and 101 do plan to transfer. It may well be that by the time a student reaches the 095-101 courses his horizon has expanded to view a possible four-year degree. In any case this is an area to be considered in the section on recommendations.

Area 7 - Clarity of Module Booklet Explanations, 091, 095, and 101 Student Attitudes (question #13)

There is a significant difference in opinions held by the students in the different developmental mathematics courses toward the module booklet explanations as can be

interpreted from Table 11 below.

Table 11. Analysis of Opinions on the Clarity of Module Booklet Explanations, Course 091, 095 and 101 Student Attitudes.

H_o: There is no significant difference between the students in courses 091, 095, and 101 in their opinion concerning the clarity of the explanations in the module booklets.

Course Number	Opinion	
	Agree	Disagree
091	32	3
095	12	11
101	19	5

Chi-square is 12.23; significant (.01); reject H_o

Table 12 below gives the tests for the pairings of the three courses to determine if the difference in students' opinions is due to one particular course. As can be seen from Table 12 only student opinions from 091 and 095 differ significantly. Whether the difference is due to a superior set of booklets for 091, an inferior set for 095, or some uhknown third factor cannot be determined from the data, but the 095 booklet could at least be examined for possible improvements.

Table 12. Analysis of Opinions on the Clarity of Module Booklet Explanations in Courses a) 091 and 095; b) 091 and 101; and 095 and 101

	Course Number	Opinion	
		Agree	Disagree
a)	091	32	3
	095	12	11
Chi-square is 11.64; significant (.001); reject H_o			
b)	091	32	3
	101	19	5
Chi-square is 1.81; not significant; fail to reject			
c)	095	12	11
	101	19	5
Chi-square is 3.79; not significant; fail to reject			

Area 8 - Quality of tutoring service (question #31)

In considering the opinions of the tutoring service the 091 and 101 groups had to be considered together as they had so few "disagree" responses. A test was run using Agree, Undecided, Disagree categories in addition to the test with Agree and Disagree only. This was done since the percentages of Undecided responses were high. Both tests summarized in Table 13 below indicated a significant difference between the 091-101 student and the 095 student attitudes. Still the high percentage of Undecided responses suggests caution

in decisions based upon these results.

Table 13: Analysis of Attitudes of 091-101 Students Versus 095 Students Concerning the Helpfulness of the Mathematics Department Tutoring Service.

Course Number	Opinion		
	Agree	Undecided	Disagree
091-101	35	24	2
095	7	14	7
Chi-square is 13.88; significant (.001); reject H_o			

	Agree	Disagree
091-101	35	2
095	7	7
Chi-square is 13.84; significant (.001); reject H_o		

The fact is that the 095 students have a significantly different opinion from the other classes about the utility of the tutoring service. Whether it is due to poor tutoring or more difficult material, steps need to be taken to improve the situation. As in the last statistical analysis the large percentage of undecided responses requires care in decision making.

Area 9 - Quantity of tutors available (question #32)

The 091 students were compared to the 095-101 students

differed significantly from the 091 students in their responses concerning the sufficiency of the number of tutors. Table 14 below summarizes the data for the chi-square test.

Table 14. Analysis of Attitudes of 095-101 Students Versus 091 Students Concerning the Quantity of Tutors Available.

Course Number	Opinion		
	Agree	Undecided	Disagree
091	15	17	4
095-101	8	33	11
Chi-square is 7.87; significant (.05); reject H_o			

	Agree	Disagree
095	15	4
095-101	8	11
Chi-square is 5.36; significant (.05); reject H_o		

VI. RECOMMENDATIONS

The following set of recommendations is a synthesis of ideas gleaned from the general student response to the questionnaire, the comparisons of subsample responses, the student comments and the author's preceptions of the developmental mathematics program. While this paper as a whole will be submitted to the mathematics department faculty for their consideration, certain of these recommendations have been and are being discussed with the faculty members in

hopes of getting more immediate action.

Recommendation 1. Supplemental Services

The mathematics department offers free tutoring, computer assisted drill, and limited audio-slide presentations. Unfortunately, 61% of the students have never used the tutoring service and not only has the computer service not been used, but 78% of the students didn't even know of its existence. Time, effort, and money have been put in these supplemental services and presently more of the same are being directed into audio-slide presentations. The data from this study makes it clear that the students are not taking advantage of these services, partially due to an unawareness of their availability. Every student should be given a tour and explanation of the facilities and services provided when first enrolling in any developmental mathematics course. These facilities should be advertised during the year throughout the campus to encourage greater student participation.

Recommendation 2. Night Courses

The night students differ in attitudes, needs, and situation from the day students. Their instructors are principally part-time faculty members, and thus have no office hours, don't know other night faculty, and are not familiar with the procedures that operate during the day. This results in wide variations in methods used. While this poses no problem in most courses, the developmental mathematics program requiresmore uniformity due to the volume of grading

and testing involved. One student indicated in her comments that their night class took each test together, whether all of the students had completed that module or not. Some students hadn't even received their homework sets back before having to take the test. This situation doesn't fit with a philosophy of self-paced instruction. An individual is needed to inform and to coordinate the efforts of the night-time faculty.

Eighty per cent of the night students work 40 hours per week or more, and therefore they have limited time to put into homework efforts. This may be the reason that 70% of the night students felt that homework should count as part of the student grade. Considering the size of this response the mathematics department should use the homework scores in determining grades for the night students or at least give each student a choice in the matter. The day students were evenly divided on this issue.

Presently the computer is not available after 5 p.m. for the night students' use. Occasionally an instructor will make special arrangements so that his class can use the computer terminals. Over 40% of the developmental mathematics students are in these night courses and they deserve the same facilities as the day students. Efforts should be made to make the computer facilities available to the night students.by hiring a professional assistant to supervise the computer room.

Recommendation 3. Placement Test

A previous study by the author indicated that the placement test performed its function. The present study showed that the students agreed--52% agree, 8% disagree and 40% undecided. The large percentage of undecided responses may be due to the fact that the placement test is only given during the first class meeting. The registration process at Cuyahoga Community College has students entering classes up to two weeks after this first meeting. Thus, many students never take the placement test, and find out the hard way whether they are in the proper course. Every student should take the placement test! Those students entering after the first meeting will take the placement exam in the testing room which is not busy during the first couple of weeks of the quarter.

Recommendation 4. Automatic Withdrawal

The present policy states that a student who finishes more than one module behind in a developmental mathematics course is given a grade of withdrawal and must retake the same course. Forty-six per cent of the respondents disagreed with this policy, while 25% agreed with it. When a student re-enrolls in the course, he resumes working from the point at which he stopped in the previous class. This means that as soon as the student finishes the remaining modules he will begin to work on the modules for the next course, but remain in the present course. For example, a student might

have to reregister for 091 to finish two modules. When finished with these modules the student would work on the units for 095 while in the 091 class. This situation would be improved if the student would have an option of going forward to the next course if he had finished at least one-half of the required modules.

Recommendation 5. Grading of Retests

Each student must pass every module test. If a student fails a test (receives less than 70%), he must be retested until he does pass. Between testing sessions the student studies his areas of deficiency. Currently the maximum score given on a retest is 70%. Eight-six per cent of the sample felt that the maximum retest score should be 80% or 90% and fifty-one per cent felt that there should be no maximum limit at all. The author agrees with this last group, but some department members feel that a person taking a retest would gain an advantage since the various forms of each test are not substantially different. The author concedes their point and accordingly suggests that samples of all of the tests be made available in the library and/or mathematics department. Certainly, there should be no mystery about what is being tested! Then a student would receive whatever score he earned whether on a retest or not.

Recommendation 6. Tutoring Service

Two significant differences of opinion were discovered by the study concerning tutoring services. The 091-101

students strongly agreed that the tutoring was very helpful while the 095 students were evenly divided in their opinions of it. The quantity of tutors was considered sufficient to avoid unreasonable waits by the 091 students (41% agree and 5% disagree), but the 095-101 students were divided (15% agree and 20% disagree). The large numbers of undecided responses is probably due to the limited student use of the tutoring service, and makes the statistical analysis questionable. Still the 091 students seem quite satisfied with the tutoring. The 095-101 student attitudes might be due to more difficult material. Since the mathematical preparation of the tutors is usually adequate, consideration should be given to the tutors' familiarity with the textual materials being used. It might be possible to introduce certain tutors to various materials and they would be the specialists for those courses. A student could go to any of the tutors for help, but certain tutors would be designated as having both the mathematical background and text familiarity for particular courses. One or both of the professional assistants in the tutoring and testing center could provide such training.

Recommendation 7. Future Writing Efforts

Only 21% of the sample felt the module booklet explanations were not clear. This is a reasonable per cent and may be due in part to students with reading difficulties. The students felt most of the module booklets are very good,

but that booklets 13, 14, and 18 need to be examined for possible improvement. The author suggests that future efforts be directed toward writing specialized modules for various majors so that an electronics major could learn about proportions by doing problems related to a Wheatstone bridge, and nursing students could learn about proportions by working on problems related to mixing solutions. A second area needing development is the writing of units on difficult topics from the higher mathematics courses. These could be used by students needing help or by students wanting to learn on their own.

Recommendation 8. Technical Aspects

A few suggestions remain that don't fit in the other categories. First, since students have relatively unlimited time in which to work out a test, have 20-25 items on every test instead of the present 10-25 items. This would give a more accurate assessment of the student's understanding and make each problem count less. Second, whenever possible homework and test graders should indicate corrections rather than merely marking problems right or wrong. Third, when there are two forms of the same booklet in circulation, avoid having both forms used in the same classroom.

VII. FURTHER STUDIES

Three areas seemed worthy of further investigation. A self-paced instructional program with limited audio-slide

presentations relies heavily upon the student's reading ability. The relationships, if any, between a student's reading level, text readability, and the student's success in the course need to be examined. The author intends to do this study as his dissertation topic. Another area emerged from the fact that only 7% of the sample are taking their mathematics courses as a job requirement. It might be of benefit to the school and the students to see what the prospective employers would like to see taught in mathematics courses. The final area for possible investigation involves the unexpected preference of night students for day classes. It might be possible to determine if this preference is due to differences in day and night courses in facilities, faculty office hours, security, frequency and length of class periods or some other reasons. It may well be that this preference for day classes is not due to some factor(s) inherent in the day program, but due to deficiencies in or problems with the night program. These difficulties, once identified, might be remedied.

VIII. SUMMARY

This study was the first step in college-wide evaluation studies of various developmental education programs. The mathematics department will want to evaluate how well the developmental mathematics program is succeeding in its original purpose of reducing the number of withdrawals and

failures. This study approached the program from the students' viewpoint, gathering their attitudes and concerns and attempting to interpret these in the form of recommendations to be considered by the mathematics faculty.

BIBLIOGRAPHY

1. Conway, Freda. Sampling: An Introduction for Social Scientists. London: George Allen and Unwin Ltd., 1967.

2. Cross, K. Patricia. Beyond the Open Door. San Francisco: Jossey-Bass, 1971.

3. Downie, N. M. and R. W. Heath. Basic Statistical Methods. 4th ed. New York: Harper and Row, Publishers, 1974.

4. Ellis, Richard B. Statistical Inference: Basic Concepts. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1975.

5. Gross, Ronald. "The Faith of the Educator". Journal of World Education, Summer, 1973.

6. Herrscher, Barton R. "A Systematic Approach to Instruction." In John E. Roueche and Barton R. Herrscher (Eds.), Toward Instructional Accountability. Palo Alto: Westinghouse Learning Press, 1973.

7. Mead, Margaret. Culture and Commitment. New York: Doubleday, 1971.

8. Parten, Mildred B. Surveys, Polls and Samples: Practical Procedures. New York: Harper and Brothers, Publishers, 1950.

9. Payne, Stanley L. The Art of Asking Questions. Princeton, New Jersey: Princeton University Press, 1951.

10. Peddiwell, J. Abner. (Harold Benjamin). The Saber-Tooth Curriculum. New York: McGraw-Hill Book Co., 1939.

11. Pirie, W. R. and M. A. Hamden. "Some Revised Continuity Corrections for Discrete Data." Biometrics, v28, 1972.

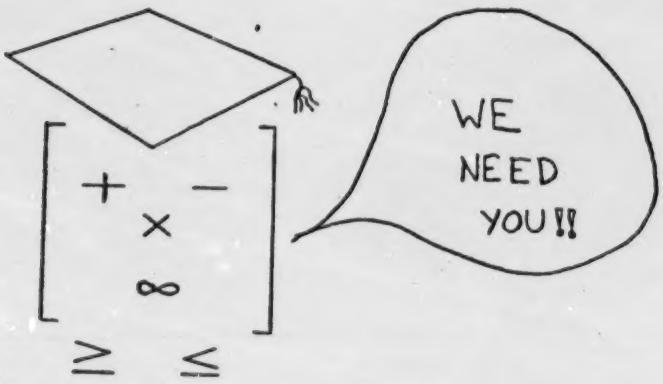
12. Saylor, Galen. "What IS Relevant to Today's Students?" Educational Leadership, October, 1973, pp. 41-44.

13. Snedecor, George W., and William G. Cochran. Statistical Methods. 6th ed. Ames, Iowa: Iowa State University Press, 1967.

14. Toffler, Alvin. Future Shock. New York: Bantam Books, Inc., 1970.

15. Wert, James E., Charles O. Neidt, and J. Stanley Ahman. Statistical Methods in Educational and Psychological Research. New York: Appleton-Century-Crofts, Inc., 1954.

APPENDIX



That is, we need your opinions about the module mathematics courses. This information will be confidential and only used for improving these courses. You are <u>not</u> to give your name. In the General Information section (questions 1-11) and for a few questions at the end of each section you are to fill in your answer or check one of the answers given. The remaining questions use the following scale: SA-A-U-D-SD with

SA meaning Strongly Agree
A meaning Agree
U meaning Undecided
D meaning Disagree
SD meaning Strongly Disagree.

You are to circle the response which best describes your reaction to the question.

GENERAL INFORMATION

1. Sex Female ___ Male ___

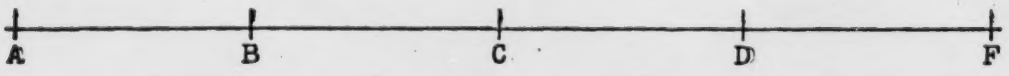
2. Age Below 20 ___ 20-24 ___ 25-29 ___ 30-34 ___ Over 34 ___

3. Program of studies Transfer (4-year) ___ Two Year ___

4. If you plan to transfer, what is your major?

   Mathematics-Science ___ Liberal Arts ___ Undecided ___

5. Indicate your present grade point average on the scale below (if known).



6. In addition to college courses, do you have a job?

   Full time (40 hours/week) ___ Part time ___ No ___

7. What is the number of this mathematics course?

   091 ___ 095 ___ 101 ___

8. When does this mathematics class meet?

   Day ___ Night ___ Weekend ___

9. When do you prefer to take mathematics courses?

   Day ___ Night ___ Weekend ___

10. How many module mathematics courses have you taken? Count every course whether or not you finished.

    ___

11. Why did you take this course?

    School requirement ___ Job requirement ___ Recommended to me ___

TEACHING METHOD

12. The student information sheet clearly explains the course structure and policies. SA-A-U-D-SD

13. The module booklets give clear explanations. SA-A-U-D-SD

14. The exercises and detailed solutions given in the module booklets are very helpful. SA-A-U-D-SD

15. The individualized module program is a good teaching method. SA-A-U-D-SD

16. I would recommend the module mathematics courses to a friend. SA-A-U-D-SD

17. I prefer the module approach to the traditional lecture-textbook approach for mathematics courses. SA-A-U-D-SD

18. How often do you feel it is necessary to attend this class?

Nearly every class ___ More than 75% of the classes ___

50-75% of the classes ___ Less than 50% of the classes ___

HOMEWORK

19. The homework sets should be part of the student's grade. SA-A-U-D-SD

20. When a student scores less than 70% correct on homework, he should do an extra set of problems. SA-A-U-D-SD

21. I feel resentful and discouraged when I get an extra set of problems to do. SA-A-U-D-SD

22. Doing extra sets of problems helps you learn. SA-A-U-D-SD

23. How many hours per week do you usually spend on your mathematics homework?

Less than 4 ___ 4-6 ___ 7-9 ___ More than 9 ___

GRADING

24. The mathematics placement test placed you in the proper course. SA-A-U-D-SD

25. A student who finishes the quarter more than one module behind should be required to retake the course. SA-A-U-D-SD

26. Studying for a final exam increases your knowledge of the course content. SA-A-U-D-SD

27. Students with a test average of 85% or more should have the option of skipping the final. SA-A-U-D-SD

28. Students with a test average of 70% or more should also be able to skip the final. SA-A-U-D-SD

29. The module mathematics courses should be graded on a pass/fail basis. SA-A-U-D-SD

30. When a student fails a test and retakes a different test, the person should receive:

A maximum of 90% ___ A maximum of 80% ___

A maximum of 70% ___ Whatever score he earns ___

SUPPLEMENTAL SERVICES

31. The free tutoring offered by the mathematics department is very helpful. SA-A-U-D-SD

32. There are enough tutors available so that students seldom have to wait for help. SA-A-U-D-SD

33. The mathematics department computer is helpful for drill. SA-A-U-D-SD

34. How often did you use the computer for mathematics practice?

I didn't know about it ___ 2-3 times/week ___

Several times/quarter ___ Never ___

35. How often did you use the tutoring service?

I didn't know about it ___ 2-3 times/week ___

Several times/quarter ___ Never ___

36. Use the space below to give any additional comments, criticisms, suggestions or praises about the module courses. In particular we would appreciate comments of questions 15, 16 and 25.

Item 2

Total Sample Responses
(n = 91)

GENERAL INFORMATION

1. Sex Female 38 Male 53

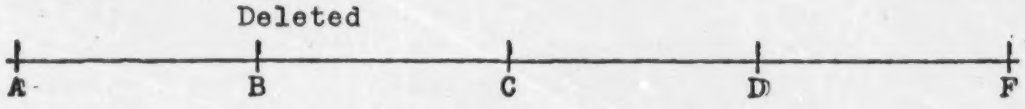
2. Age Below 20 23 20-24 33 25-29 21 30-34 5 Over 34 8

3. Program of studies Transfer (4-year) 44 Two Year 38

4. If you plan to transfer, what is your major?

Mathematics-Science 30 Liberal Arts 20 Undecided 41

5. Indicate your present grade point average on the scale below (if known).



6. In addition to college courses, do you have a job?

Full time (40 hours/week) 40 Part time 20 No 41

7. What is the number of this mathematics course?

091 ___ 095 ___ 101 ___

8. When does this mathematics class meet?

Day 51 Night 40 Weekend ___

9. When do you prefer to take mathematics courses?

Day 59 Night 29 Weekend ___

10. How many module mathematics courses have you taken? Count every course whether or not you finished.

Deleted

11. Why did you take this course?

School requirement 62 Job requirement 6 Recommended to me 20

A = Agree U = Undecided D = Disagree

TEACHING METHOD

		A	U	D
12.	The student information sheet clearly explains the course structure and policies.	85	0	4
13.	The module booklets give clear explanations.	63	8	19
14.	The exercises and detailed solutions given in the module booklets are very helpful.	80	6	3
15.	The individualized module program is a good teaching method.	80	6	4
16.	I would recommend the module mathematics courses to a friend.	72	10	7
17.	I prefer the module approach to the traditional lecture-textbook approach for mathematics courses.	76	5	10

18. How often do you feel it is necessary to attend this class?

Nearly every class 54 More than 75% of the classes 22

50-75% of the classes 12 Less than 50% of the classes 4

HOMEWORK

		A	U	D
19.	The homework sets should be part of the student's grade.	40	6	35
20.	When a student scores less than 70% correct on homework, he should do an extra set of problems.	65	17	9
21.	I feel resentful and discouraged when I get an extra set of problems to do.	35	23	28
22.	Doing extra sets of problems helps you learn.	78	7	2

23. How many hours per week do you usually spend on your mathematics homework?

Less than 4 38 4-6 47 7-9 4 More than 9 2

GRADING

		A	U	D
24.	The mathematics placement test placed you in the proper course.	47	34	7
25.	A student who finishes the quarter more than one module behind should be required to retake the course.	23	24	42

		A	U	D
26.	Studying for a final exam increases your knowledge of the course content.	50	19	20
27.	Students with a test average of 85% or more should have the option of skipping the final.	79	6	4
28.	Students with a test average of 70% or more should also be able to skip the final.	24	22	43
29.	The module mathematics courses should be graded on a pass/fail basis.	20	25	42

30. When a student fails a test and retakes a different test, the person should receive:

A maximum of 90% 16 A maximum of 80% 15

A maximum of 70% 11 Whatever score he earns 46

SUPPLEMENTAL SERVICES

		A	U	D
31.	The free tutoring offered by the mathematics department is very helpful.	42	38	9
32.	There are enough tutors available so that students seldom have to wait for help.	23	50	15
33.	The mathematics department computer is helpful for drill.	13	68	4

34. How often did you use the computer for mathematics practice?

I didn't know about it 71 2-3 times/week 4

Several times/quarter 1 Never 22

35. How often did you use the tutoring service?

I didn't know about it 5 2-3 times/week 8

Several times/quarter 18 Never 56

36. Use the space below to give any additional comments, criticisms, suggestions or praises about the module courses. In particular we would appreciate comments of questions 15, 16 and 25.

UNIVERSITY OF CALIF.
LOS ANGELES

JUN 20 1975

CLEARINGHOUSE FOR
JUNIOR COLLEGE
INFORMATION